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(54) Title: PROCESS AND FORMULATION FOR LOW TEMPERATURE SPREADABLE TABLE SPREAD

(57) Abstract

A reduced–fat table spread which is spreadable at refrigeration temperature, and up to 20 °C to 25 °C, has the appearance, flavour, consistency, rheology, and mouth–feel, which is similar to that of butter or margarine. However, the reduced–fat table spread includes a significant portion of non–fat milk solids, together with water, and vegetable oil. A further colloid carrier may also be included in the formulation of the reduced–fat table spread, together with other optional trace elements, including salt, potassium sorbate, sodium benzoate, citric acid, lecithin, butter flavour ingredient, butter culture ingredient, and colour ingredient. The table spread is soft, but has a solid appearance, and is spreadable at refrigeration temperature and up to room temperature. These factors are achieved as a consequence of protein coagulation at elevated temperatures of a stirred mixture of the starting materials; whereby the water content of the table spread is bound by the protein constituents thereof in a continuous phase dispersion. The vegetable oil content, on the other hand, is present in a discontinuous phase, suspended in the continuous phase dispersion. During production of the reduced–fat table spread, the product is not homogenized until after protein coagulation at elevated temperatures has taken place.

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PROCESS & FORMULATION FOR LOW TEMPERATURE SPREADABLE TABLE SPREAD

FIELD OF THE INVENTION:

This invention relates to reduced-fat table spreads which are spreadable at low temperatures. More particularly, the present invention is directed towards table spreads which comprise non-fat milk solids as a principal constituent, but which also comprise vegetable oil as the fat constituent, together with water and other ingredients normally found in margarines and table spreads, as well as in butter. The reduced-fat table spreads of the present invention have the same general appearance and consistency as butter or margarine when first removed from a refrigerator, but they are spreadable immediately after they have been removed from the refrigerator. In other words, the table spreads of the present invention are spreadable at refrigeration temperatures which are usually in the range of 3°C to 10°C; moreover, the table spreads maintain their appearance and integrity even if stored at room temperature for an hour or two.

An ancillary purpose of the present invention is to provide a reduced-fat table spread having a lower caloric content than butter and than many margarines, and having substantially no appreciable cholesterol content. The table spreads of the present invention can be used for the same general purposes as butter and margarines, except for frying and some baking.

BACKGROUND OF THE INVENTION:

Ordinary butter continues to remain the spread of choice, particularly for such uses as with breads, rolls, buns, and the like, for purposes of greater palatability of those bread products, and for flavour. However, ordinary butter is difficult to handle, in that it must be kept refrigerated and yet it is not spreadable when it is removed from the refrigerator. As ordinary butter warms up to room temperature, its appearance tends to change, taking on an oily appearance; and,

as well, its structural integrity tends to change to some extent in that it will slump if it is maintained at room temperatures for prolonged periods of time. Moreover, butter will tend to spoil much more quickly if it is kept at room temperatures for prolonged periods of time.

Margarines have been developed as substitutes for butter. However, most margarines are still considered to be highly manufactured, chemical products and, as such, they tend to be looked upon as less than satisfactory substitutes or replacements for butter. Indeed, some people object to the flavour or lack of flavour or margarines, their greasiness, or other characteristics of margarines which distinguish them from butter. Moreover, there remains a tendency for many consumers to want to consume a butter-like spread, particularly on bread products as well as being placed on cooked vegetables and the like, because of the presence of milk ingredients in butter or butter/margarine mixtures.

However, the challenge still remains to provide a table spread which is spreadable at refrigeration temperatures, while avoiding the greasiness of margarine and, at the same time, incorporating non-fat milk solids as a principal ingredient thereof. In particular, the challenge still remains to provide a product having a solid appearance while yet being spreadable at refrigeration temperatures; and particularly a product which has a lower fat content than ordinary margarines or butter, but one where the fat content is stabilized and does not separate or become only or greasy over time or at room temperature.

The dairy industry has approached the problem by attempting to provide spreadable butter-like compositions which have a number of the same constituents as butter, but which may be spreadable at refrigeration temperatures in the same manner that margarine is spreadable at refrigeration temperatures. For example, AHMED *et al*, United States patent No. 4,769,255 provides a butter-like composition which is produced by phase reversal of an oil-in-water emulsion, having about 40% fat content, so as to become a predominantly water-in-oil emulsion, where the water is in a discontinuous phase and the oil is in a continuous phase. Because the ratio of water-in-oil emulsion to oil-in-water emulsion must be in the range of 6:4 to 9:1, the product tends to become unstable.

Also, as noted, the Ahmed *et al* product retains a relatively high fat content of about 40%.

Two other United States patents, also issued to AHMED *et al*, are United States patent No. 4,961,950, where the total fat content of the composition is at least 30%; and United States patent no. 4,970,087, where the product is a mixture of water-in-oil emulsion and oil-in-water emulsion where the ratio of the emulsions is 6:4 to 8.5:1, and the composition is dispensable from a manually-operated squeezable container, much the same as mustard, ketchup, or toothpaste.

ANDERSSON United States patent No. 4,511,591 teaches a spreadable fat product which comprises 35% to 55% fat, 4% to 7% ultra-filtrated milk protein, and 41% to 58% water. The fat is in the form of spheres, each of which is smaller than 10μ. The fat and water form an oil-in-water emulsion, with the protein forming shells around the fat spheres so as to stabilize the emulsion. The fat product is said to be spreadable at refrigerator temperature, and it is free from additives in the form of stabilizing agents and/or emulsifiers. The manufacture of the spreadable fat product first requires that milk be pasteurized and then ultra-filtrated after cooling in order to achieve a protein concentrate. Taste cultures, providing flavour such as butter, yoghurt, and kefir may be added.

FACKRELL *et al* United States patent No. 5,487,913 teaches a reduced fat content butter product which is an emulsion of a liquid in a fat, to which lecithin and/or a stabilizer may be added.

It must be noted that butter is a water-in-oil emulsion. That is to say, butter is a colloidal system — a colloid being a state of matter in which one substance is finely dispersed in another substance — where the fat content is in a continuous phase. Moreover, butter comprises 80% by weight of butterfat, so that the lipid phase of butter is essentially solidified at refrigeration temperatures and will not liquify or soften until it has been removed from the refrigerator and is permitted to warm up towards room temperature. On the other hand, margarines provide for spreadability at refrigeration temperature by using oils that have lower melting curves; but margarines remain also a product where the fat content is in a continuous phase.

The present invention, on the other hand, provides a table spread where a vegetable oil is used as the fat content thereof, but the vegetable oil is held in a suitable carrier in a discontinuous phase, so that the vegetable oil is held in suspension in the carrier. Moreover, a principal constituent of the carrier is non-fat milk solids. Other constituents which may also be utilized in the carrier are discussed hereafter.

The present inventor has quite unexpectedly discovered that the water content of a reduced-fat table spread, where the fat constituent is a vegetable oil, can be bound by the protein constituents which are utilized in the formulation of a low calorie table spread which is spreadable at low temperatures; and, moreover, that when a slurry of non-fat milk solids and other carrier ingredients, if desirable, is prepared the fat content of the table spread can be dispersed throughout the mixture in a discontinuous phase. Thus, a low temperature spreadable butter substitute, which essentially has the same appearance, flavour, consistency, rheology, and mouth-feel of butter of margarine, but without the greasiness of margarine, is provided.

As described in greater detail hereafter, the spreadability of the table spread of the present invention comes as a consequence of protein swelling and coagulation, and the water binding properties thereof, which are developed from a suspension of dry milk solids, and wherein the fat content is dispersed in a slurry which is homogenized and cooled, all as discussed hereafter. Therefore, the table spread of the present invention displays the properties of a continuous water phase and a discontinuous fat phase. That factor, in turn, contributes to the spreadability of the table spread of the present invention, since the fat phase is distributed throughout the product, and is unagglomerated.

Accordingly, it is the purpose of the present invention to provide a reduced-fat table spread that is spreadable at refrigeration temperature, and at temperatures up to 25°C, and which has an appearance, flavour, consistency, rheology, and mouth-feel similar to that of butter or margarine.

In its broadest sense, the table spread of the present invention has a formulation comprising 45% to 60% by weight of water, 5% to 20% by weight

of non-fat milk solids having protein constituents, 0 to 5% of other protein and colloid carrier constituents chosen from the group consisting of gums, starches, egg whites, albumen, and mixtures thereof, together with 30% to 50% by weight of vegetable oil. Additionally, the formulation may comprise 0% to 1.2% by weight of salt, and zero to trace amounts of potassium sorbate, sodium benzoate, citric acid, lecithin, butter flavour ingredient, butter culture ingredient, and colour ingredient. Each of the butter flavour ingredient, butter culture ingredient, and colour ingredient, when they are used, is compatible with the vegetable oil and with the non-fat milk solids. A principal feature of the present invention is that the water content of the table spread is bound by the protein constituents of the non-fat milk solids, and by the other protein and colloid carrier constituents when they are present, in a continuous phase dispersion of the water throughout the table spread product. Moreover, the vegetable oil content is in a discontinuous phase, suspended in the continuous phase dispersion of the water content.

Still further, the present invention provides, in its broadest terms, a method for production of a reduced-fat table spread which is spreadable at refrigeration temperature, and at temperatures up to 25°C. The formulation of the table spread is as described above, it being noted, once again, that the water content of the table spread is bound by the protein constituents of the non-fat milk solids, and by other protein additives such as egg white, as well as by the other colloid carrier constituents, when the protein additives and/or other colloid constituents are used so that the water content of the table spread is bound, in a continuous phase dispersion throughout the product; whereas the vegetable oil content is in a discontinuous phase suspended in the continuous phase dispersion. The method for production of the reduced-fat table spread comprises the following steps:

(a) A quantity of non-fat milk solids is selected, and those non-fat milk solids are added to a selected quantity of water. The temperature of the water is 2°C to 40°C.

(b) The non-fat milk solids and water are continuously stirred, while maintaining the temperature thereof below 40°C, so as to form a milk solids slurry.

(c) Optionally, a selected quantity of other protein and colloidal carrier constituents such as gums, starches, egg whites, albumen, and mixtures thereof, as noted above, may also be added to the milk solids slurry, while maintaining the temperature thereof below 40°C.

(d) Then, a selected quantity of vegetable oil is added to the continuously stirred milk solids slurry, while again maintaining the temperature thereof below 40°C, so as to form a continuously stirred milk solids slurry mixture.

(e) Any of the optional trace amount ingredients which are to be added to the formulation of the reduced-fat table spread are then added to the continuously stirred milk solids slurry mixture, again while maintaining the temperature thereof below 40°C. Thus, the vegetable oil and any of the optional added trace amount ingredients will be held in suspension in the continuously stirred milk solids slurry mixture.

(f) Thereafter, the continuously stirred milk solids slurry mixture is heated to a temperature of 72°C to 90°C, and it is maintained at that temperature of 72°C to 90°C for a period of 10 seconds to 10 minutes. By so doing, coagulation of the protein constituents of the non-fat milk solids, and of the other protein and colloid carrier constituents when they are present, is achieved. At the same time, the stirred milk solids slurry is pasteurized.

(g) Thereafter, the heated milk solids slurry mixture is homogenized at a temperature of 25°C to 72°C.

(h) Afterwards, the homogenized mixture is transferred through a heat exchanger to a filling machine, and the temperature of the homogenized mixture is reduced to 8°C to 15°C.

(i) Selected quantities of the homogenized, cooled mixture are then transferred to containers therefor, for storage as reduced-fat table spread.

In keeping with the general teachings of the present invention, the method for production of the reduced-fat table spread hereof will usually comprise one further step, namely:

(j) The reduced-fat table spread is stored at temperatures below 8°C.

It must be particularly noted that, contrary to other prior art methods for production of reduced-fat dairy spreads or table spreads, there is no water driven off from the starting materials. The firmness, but spreadability, of the table spread comes as a consequence of protein coagulation of the protein constituents of the dry milk solids which are part of the formulation, as well as that of any of the colloid carrier constituents when they are used. That protein coagulation is carried out at temperatures above 72°C; and it is such as to develop an excellent water binding property of the coagulated proteins. Thus, the water remains within the table spread as a continuous phase; and the fat content is found in the table spread in a discontinuous phase.

The dry milk solids which are used in keeping with the present invention may be dried skim milk solids, dried buttermilk solids, dry casein solids, dry caseinates, dry whey protein solids, and mixtures thereof. All of those milk solids are proteins, lactoses, or other complex carbohydrates, and all are derived from milk.

Also, as noted above, additional protein and other colloid carrier constituents may be used together with the non-fat milk solids, and those other protein and additional colloid carrier constituents may be appropriate gums, starches, egg whites, albumen, and mixtures thereof. Their use may be predicated, at least in part, so as to arrive at a slurry mixture which has a desired thickness or stiffness.

Moreover, the use of any of the additional other protein and colloid carrier constituents, or of such other trace additives as a colour ingredient, will only occur where the local regulations covering such additives in butter-like or margarine-like products will permit their use.

In a preferred embodiment of the present invention, the water content and at least a portion of the non-fat milk solids content are derived from skim milk. Further, the skim milk may have been fortified with additional non-fat milk solids so as to provide the intended specific content of non-fat milk solids to be found in the specific reduced-fat table spread being manufactured. Egg whites may also

be employed because they consist entirely of protein, and therefore contribute to the stiffening and water binding characteristics of the protein constituents of the table spread in keeping with the present invention.

Also, the water content and at least a portion of the non-fat milk solids content may be derived from a mixture of water and whey. It is possible that the entire intended non-fat milk solids content, and the entire intended water content of the reduced-fat table spread being manufactured may be derived from the mixture of water and whey, or liquid whey. Otherwise, the mixture of water and whey may be fortified with additional non-fat milk solids so as to provide the intended non-fat milk solids content.

Likewise, the water content and the non-fat milk solids content of the reduced fat table spread being manufactured may be derived from a mixture of skim milk and whey. Once again, that mixture may be fortified with additional non-fat milk solids, if necessary.

Of course, the present invention provides alternative methods to that which has been summarized above, so as to provide for appropriate starting materials chosen from water, skim milk, whey, and non-fat milk solids. More specific discussion, and discussion of various operating parameters which may be employed in conducting the processes of the present invention for production of reduced-fat table spreads, are described in greater detail hereafter.

BRIEF DESCRIPTION OF THE DRAWINGS:

The novel features which are believed to be characteristic of the present invention, as to its structure, organization, use and method of operation, together with further objectives and advantages thereof, will be better understood from the following drawings in which a presently preferred embodiment of the invention will now be illustrated by way of example. It is expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention. Embodiments of this invention will now be described by way of example in association with the accompanying drawings in which:

Figure 1 is a semi-graphical illustration showing a typical oil-in-water emulsion, as would be found in the prior art;

Figure 2 is a semi-graphical illustration showing a suspended vegetable oil content of a reduced-fat table spread of the present invention in a continuous phase dispersion thereof; and

Figure 3 is a graphical flow chart showing the steps and specific apparatus employed during the production of a reduced-fat table spread of the present invention, in keeping with a typical manufacturing process therefor.

DETAILED DESCRIPTION OF THE INVENTION:

The reduced-fat table spread, and the process for its production, as provided for by the present invention, have been described above in general terms. What follows are more particular comments which provide a more specific understanding of certain aspects of the invention. In particular, some discussion will be directed to the fact that the water content of the table spread is bound by the protein constituents of the non-fat milk solids, and by the other protein and colloid carrier constituents when they are present, in a continuous phase dispersion throughout the reduced-fat table spread product; whereas the vegetable oil content is in a discontinuous phase which is suspended in the continuous phase dispersion throughout the product.

Thus, Figure 1 shows a semi-graphical representation of a prior art water-in-oil emulsion. A block 20 of prior art table spread or low-calorie dairy spread is shown, having a continuous phase-fat content 22 (shown by rectangular cross hatching) in which a discontinuous water phase 24 (shown by dashed hatching) is found. On the other hand, Figure 2 shows a semi-graphical representation of block 30 which, in keeping with the present invention, comprises the water content 34 (shown by dashed hatching) in a continuous phase, and in which the vegetable oil content 32 (shown by rectangular cross hatching) is found in a discontinuous phase.

For the most part, the reduced-fat table spread of the present invention should be indistinguishable from butter or better quality margarines, as to its taste,

flavour, and appearance. However, the reduced-fat table spread of the present invention is spreadable at refrigeration temperatures, and it tends to retain its structural integrity and does not adopt a greasy or oily appearance if it has been maintained at room temperature for a period of, say, up to several hours.

Because the reduced-fat table spread of the present invention is spreadable at refrigeration temperatures, it is generally stored in plastic tubs because it is not adaptable to being wrapped with foil or parchment paper wrappers in the same manner as conventional butter or some margarines which are manufactured from harder oils and which, therefore, lack the capability of being spreadable at refrigeration temperatures.

The present invention is distinguished from the prior art, insofar as the main thrust of the prior art is phase reversal of an oil-in-water emulsion to become a water-in-oil emulsion. Such prior art teachings are thus generally directed to providing table spreads that are in keeping with the "margarine process" for the production thereof.

Rather, the present invention is predicated on the fact that, if a milk protein slurry is created and is stirred so that the milk solids that are held in suspension within the slurry, the milk protein will swell and adsorb water. Additional protein colloid carrier constituents may also be included in the non-fat milk solids slurry, as noted above, and they also contribute to the ability of the slurry to absorb water. Moreover, vegetable oil is added to the slurry. Then, if the slurry is heated to a temperature above 72°C and up to 90°C, and is held at that elevated temperature for a period of time — which may be quite a short period of time, as noted hereafter — the protein constituents of the non-fat dry milk solids and of the other protein and colloid carrier constituents, if present, will coagulate and will develop and demonstrate a profound water-binding property or capability. The water-binding property may be as much as from 1 to 2 weight units, and up to 7 to 10 weight units, of water being bound by 1 weight unit of protein or other colloid carrier constituent. In other words, the water will be bound by the non-fat dry milk solids, and the other protein and colloid carrier constituents if present, and will thereby be found in a continuous phase dispersion.

On the other hand, whatever fat molecules are in the slurry from the vegetable oil content thereof will be distributed throughout the slurry in a discontinuous phase.

Then, the slurry can be homogenized at a slightly lower temperature so as to obtain uniformity of particle size and dispersion of fat and bound water throughout the slurry. Again, as noted, the fat is in a discontinuous phase, and the water is in a continuous phase — notwithstanding that the water is bound by the protein constituents or other colloid carrier constituents if present, within the reduced-fat table spread.

Thereafter, the temperature of the homogenized slurry can be reduced and the homogenized slurry can be maintained at a reduced temperature until such time as quantities thereof are dispensed into containers from a filling machine, where the homogenized chilled slurry has, by that time, been reduced essentially to refrigeration temperature; and, thereafter, the dispensed product in its containers can be stored at refrigeration temperatures as reduced-fat table spread.

All of the above discussion, directed to the present invention, and the discussion which follows, is made having regard to the description of the method for production of a reduced-fat table spread, comprising steps (a) through (j), as particularly described above.

It has been noted above, that at an appropriate time during the process for production of reduced-fat table spreads according to the present invention, additional additives may be added to the initial continuously stirred milk solids slurry which, by that time, would also include the vegetable oil constituent, so as to form a continuously stirred milk solids slurry mixture. Those additional additives may include salt, potassium sorbate, sodium benzoate, and citric acid, which are utilized as preservatives; lecithin, which is phospholipid, and which is utilized so as to improve the spreadability characteristic of the product; as well as typical butter flavour ingredients, butter culture ingredients, and colour ingredients. Generally such colours are annato colours or beta carotene; and each of the butter flavour ingredient, butter culture ingredient, and colour ingredient, is such that it is compatible with the vegetable oil and the non-fat milk solids.

As noted above, at the time that the additional ingredients discussed immediately above are added to the continuously stirred milk solids slurry, the slurry remains unhomogenized.

However, while it is usual that all of the additional trace ingredients, if used, are added at the same time, prior to the slurry being heated to a temperature of 72°C to 90°C, and maintained at that temperature for a period of 10 seconds to 10 minutes, it is possible that the butter flavour ingredient may be added to the mixture after it has been heated to a temperature of 72°C to 90°C, but before the milk solids slurry mixture is homogenized.

All of the machines in which the various steps — as particularly enumerated above — of the process according to the present invention may be carried out, are ones which would normally be found in a conventional bulk milk handling and packaging facility — typically, a commercial dairy, where packaged milk products are prepared for the market. The machines may also be typically found in many margarine production facilities. For example, appropriate tanks having capacities of many thousands of litres, as may be required, may be found in a conventional milk handling and packaging facility, commercial dairy, or margarine production facility. Moreover, such tanks will be located and associated with temperature controls, or in temperature controlled rooms, so that the contents of the tanks may be held at whatever the temperature is required to be for the particular step being undertaken.

Likewise, the tanks which are necessary equipment to heat a stirred mixture up to a temperature of 72°C to 90°C, and maintain the stirred mixture at that temperature for a sufficient period of time to permit coagulation of the protein constituents of the non-fat milk solids or other protein and colloid carrier constituents when present, will be found in an ordinary commercial bulk milk handling and packaging facility or margarine production facility. Still further, homogenizing equipment will be found in such bulk milk handling and packaging facilities, or margarine production facilities. A more specific example of a typical manufacturing process, and the machinery used in carrying out that process, is given below.

It should be noted that the step of heating a stirred mixture to a temperature of 72°C to 90°C, and maintaining the heated mixture at that temperature for a period of time will serve two purposes. First, the stirred mixture will be pasteurized. Also, maintaining the heated mixture at that temperature for a period of time will permit swelling and coagulation of the protein constituents of the non-fat milk solids, or of the colloid carrier constituents if present, and thus there will develop the water-binding property thereof. The period of time may vary from a matter of a few seconds up to a longer period of time. Generally, 10 seconds to 10 minutes is considered to be the practical range for that step; and, typically, the step of heating the continuously stirred mixture to a temperature of 72°C to 90°C, and maintaining the continuously stirred mixture at that temperature, will be carried out for 35 seconds to 60 seconds or more.

The step of homogenization is carried out in equipment of the sort which will be found in every commercial bulk milk handling and packaging facility, or margarine production facility. Moreover, the heat exchanger through which the homogenized mixture is transferred from a temperature controlled holding tank to a filling machine may particularly be a swept surface heat exchange unit. Once again, a swept surface heat exchange unit might typically be found in a commercial bulk milk handling and packaging facility, or margarine production facility.

The finished product, as it is transferred to the containers in which it will be stored and sold — usually, plastic containers of the sort in which margarine, soft processed cream cheese, processed sour cream, cottage cheese, and the like, are sold — will thus be a product which has substantially the same rheology or consistency of margarine or the prior art manufactured butter-type spreads, or margarine/butter mixtures. However, as noted, the packaged table spread of the present invention will have a reduced fat, reduced calorie, and reduced cholesterol content than convention butters and most conventional margarines. It will also contain non-fat milk solids — unlike conventional margarines — and vegetable oil — unlike butter.

It is important to note that the heated stirred mixture must be heated to a temperature of at least 72°C so as to ensure that the fat content thereof has completely liquified, so that there are no fat crystals or fat crystal nuclei in the mixture.

Moreover, the heated stirred mixture should not be heated above about 90°C, so as to preclude any risk of localized boiling of the water content of the mixture. This precludes the likelihood of scorching of any of the milk solids, and it precludes loss of water content due to evaporation.

Typically, the vegetable oil which is utilized in the production of reduced-fat table spreads according to the present invention will present a melting curve characteristic, measured on a nuclear magnetic resonance (N.M.R.) basis, as follows:

10°C — 40-60
20°C — 10-26
30°C — 0-5

In particular, the vegetable oil which is employed, so as to carry out the production of reduced-fat table spreads according to the present invention, may be unhydrogenated vegetable oils, hydrogenated vegetable oils, blended vegetable oils, and mixtures thereof.

However, it is possible that the oils can be softer than the above, depending on the stiffness of the slurry, so that more non-fat solids can be added. Accordingly, the range of non-fat milk solids utilized may be from 5% up to 20% by weight of the product. Additionally, up to 5% of other protein and colloid carrier constituents, as described above, may also be utilized in the production of the reduced-fat table spreads of the present invention.

A general formulation for reduced-fat table spreads in keeping with the present invention will be within the ranges of the various constituents and ingredients thereof, as follows, where the amount of any constituent is expressed in terms of per cent by weight:

TABLE I

water	45% - 60%
non-fat milk solids	5% - 20%
vegetable oil	30% - 50%
salt	0 - 1.2%
potassium sorbate	0 - 0.15%
sodium benzoate	0 - 0.15%
citric acid	0 - 0.15%
lecithin	0 - 0.60%
butter flavour or butter culture	0 - 0.35%
butter colour	0 - 0.03%
other protein and colloid carrier constituents	0 - 5%

As noted, the non-fat milk solids are derived from the group consisting of dried skim milk solids, dried buttermilk solids, dry casein solids, dry caseinates, dry whey protein solids, and mixtures thereof. A specific non-fat milk solid which may be particularly employed in carrying out the present invention is sodium caseinate. The other protein and colloid carrier constituents are derived from the group consisting of gums, starches, egg whites, albumen, and mixtures thereof.

A typical formulation for a reduced-fat table spread, in keeping with the present invention, and which has been manufactured in keeping with the process steps described above, where the slurry mixture was heated to a temperature of 72°C and maintained at that temperature for a period of 35 seconds to 60 seconds, before being homogenized, is as follows:

TABLE II

water	48%
non-fat milk solids	12%
vegetable oil	38%
salt	1%
potassium sorbate	0.10%
citric acid	0.10%
lecithin	0.50%
butter flavour or butter culture	0.28%
butter colour	0.02%

It has been noted above that there may be alternative starting materials other than water and non-fat milk solids *per se*. Specifically, it has been noted that water, or skim milk, or whey may be employed; and, indeed, it is possible that the intended content of non-fat milk solids may be derived from whey.

In a preferred embodiment, the water content and at least a portion of the non-fat milk solids content of the reduced-fat table spread of the present invention, are derived from skim milk. Moreover, it is possible that the skim milk may have been fortified with additional non-fat milk solids so as to provide the intended content of from 5% to 20% by weight of non-fat milk solids for the reduced-fat table spread being produced. Still further, egg whites may be employed as a specific protein additive, and so as to enhance the water binding characteristics of the protein constituents of the reduced-fat table spread of the present invention.

Accordingly, in keeping with steps (a) and (b) of the process of the present invention, as enumerated above, step (a) would comprise selecting a quantity of non-fat milk solids and adding the non-fat milk solids to a selected quantity of skim milk, where the temperature of the skim milk is 2°C to 40°C. This would then be followed directly, or after step (c), by step (d) in which the non-fat milk solids and skim milk would be continuous stirred so as to form a milk solids slurry, while maintaining the temperature thereof below 40°C, as noted above. The process of manufacture, following step (e) through (j) would then continue in the manner as discussed above.

In a further alternative of the present invention, the water content and at least a portion of the non-fat milk solids content of the reduced-fat table spread may be derived from a mixture of water and whey. Indeed, it is possible that the entire water content and non-fat milk solids content of the reduced-fat table spread being produced may be derived from water and whey. Alternatively, such a mixture may be fortified with additional non-fat milk solids.

Accordingly, step (a) of the process of the present invention, as described above, may comprise the step of selecting a quantity of whey and adding the whey to a selected quantity of water, where the temperature of the water is 2°C

to 40°C. Likewise, step (b) would comprise the step of continuously stirring the whey and water so as to form a milk solids slurry, the temperature of which would be maintained below 40°C.

In yet a further alternative embodiment of the present invention, the water content and non-fat milk solids of the reduced-fat table spread being produced may be derived from a mixture of skim milk and whey. Moreover, that mixture may, once again, be fortified with additional non-fat milk solids.

In that case, step (a) of the process of the present invention, as described above, would comprise the step of selecting a quantity of whey, and adding the whey to a selected quantity of skim milk. Once again, the temperature of the skim milk would be 2°C to 40°C. Likewise, step (b) consists of continuously stirring the whey and skim milk so as to form a milk solids slurry, whose temperature would be maintained below 40°C.

Still further, in any of the methods of the present invention, depending on the starting materials being water, skim milk, whey, non-fat milk solids, and appropriate mixtures thereof, the temperature at which each of steps (a), (b), (c), (d), and (e) is carried out, may be selected to be between 2°C to 20°C. Moreover, the temperature of the water or skim milk which is used in step (a) of any process in keeping with the present invention, may be from 2°C to 5°C, whereas the temperature of the vegetable oil which is utilized in step (d) may be 20°C to 40°C. Each of steps (b), (c), (d), and (e) may be carried out at 20°C to 40°C.

Turning now to Figure 3, a typical process flow chart is graphically illustrated, concerning which a typical example of production of a reduced-fat table spread in keeping with the present invention will be discussed. In the following example, certain discussion of operating parameters is given. However, it is understood that the discussion of the machinery used and the operating parameters thereof is strictly exemplary, for purposes only of providing a fuller and more complete understanding of the present invention, and is not intended to be limiting in any way or manner, whatsoever.

Throughout Figure 3, several pumps are graphically shown. This is not to suggest, however, that they are the only pumps which are used; they are shown

because, typically, the viscosity of the liquid being handled by any specific pump may have changed in the last processing machine or piece of equipment immediately preceding that particular pump.

A skim milk or water tank 40 and a vegetable oil tank 42 are typically located on the floor of the processing or manufacturing facility. A typical tank may have a 30,000 litre capacity. The temperature of the skim milk or water stored in tank 40 is usually from 2°C to 5°C; whereas the temperature of the vegetable oil stored in tank 42 will be kept at about 40°C, or at least in the range of from 20°C to 40°C.

As noted above, milk proteins, or some of them, may already be present in the skim milk if that is what is being stored in tank 40. In any event, the skim milk or water is transferred from tank 40 to a blender 44, and the viscosity of the skim milk or water, whose temperature may be in the range of from 2°C to 5°C, may be 370 cPs. In any event, the non-fat milk solids and optional colloid carrier constituents may be added from a tank or tanks shown generally at 46, from which they are transferred to the blender 44. It should also be noted that whey may also be stored in the tank 40, or it is possible that it may be stored in one of the tanks or other storage equipment shown generally by the reference numeral 46. While the non-fat milk solids and water, skim milk, or whey (as the case may be) are held in the blender 44, they are continuously stirred so as to form a milk solids slurry, as noted above. The blender may be a water jacketed blender, and it may be employed to raise the temperature of the milk solids slurry to a temperature below 40°C, usually in the range of from 20°C to 40°C. The slurry is then pumped using pump 45 to a mixer 47. Also, vegetable oil is pumped from the vegetable oil tank 42 using pump 43 into mixer 47.

The viscosity of the slurry delivered from the blender 44 to the mixer 47, at a temperature of 40°C for example, may be 250 cPs. Likewise, the viscosity of vegetable oil delivered from tank 42 to the mixer 47 at 40°C may also be in the range of from 250 cPs to 300 cPs.

As noted above, trace ingredients may be added to the slurry mixture in the mixer 47, from a series of appropriate tanks or bins shown generally at 48.

Typically, the viscosity of the slurry within the mixer 47 may then be 300 cPs at 40°C. The pH of the slurry may be about 5.4.

The slurry is then pumped using pump 49 to a balance tank 50 which will work in conjunction with pump 51 and pasteurizer 52. A typical pasteurizer may include a seven minute holding tube 60 as a by-pass thereof and it will, in any event, comprise both a heater unit 70 and a cooler unit 72. A typical pasteurizer will have a capacity of 1,500 litres per hour with a pasteurizing temperature of 90°C, and a holding time of seven minutes. The viscosity of the slurry as it is pasteurized at 90°C will typically be 120 cPs.

The slurry will generally be cooled to a temperature of about 60°C and a viscosity of 188 cPs in the pasteurizer 52; and, when capacities such as that mentioned above are being processed by equipment as being described herein, it is usual that a surge tank 54 will be employed. From the surge tank, the slurry is pumped using pump 53 to an homogenizer 56. A typical homogenizer is a two-stage homogenizer, with the viscosity of the slurry being delivered to it at 60°C being 188 cPs, and the viscosity of the homogenized slurry being delivered from the homogenizer, also at 60°C, being 2,500 cPs. In a typical two-stage homogenizer, the first stage operates at 2,100 psi to 2,200 psi; the second stage typically operates at 500 psi to 600 psi.

From the homogenizer 56, the homogenizer slurry is transferred to a heat exchangers 58 and 62. The homogenized mixture may then be transferred from the heat exchanger 62 through a surge tank 64 at a temperature of about 15°C, and a viscosity of 32,000 cPs. The surge tank operates in conjunction with a filling machine 66, to which the chilled homogenized slurry is pumped using pump 65 at a temperature of 8°C to 15°C. The filling machine delivers a packaged product, typically in plastic tubs, as shown at 68.

The physical appearance of the reduced-fat table spread, which is spreadable at refrigeration temperatures, comes particularly as a consequence of the protein coagulation of the heated stirred mixture thereof. Moreover, that physical appearance retains essentially the same appearance, even if the reduced-fat table spread has been maintained at room temperature for a period of up to

several hours. Penetrometer tests suggest that the product does, indeed, become softer as it remains exposed to warmer ambient temperatures, such as room temperature, for periods of up to several hours; but there is one test which is not readily quantifiable but easily demonstrable, and which demonstrates the capability of reduced-fat table spreads in keeping with the present invention to maintain its physical integrity while remaining spreadable even at room temperature.

That test is the so-called "warm toast" test. Several slices of ordinary warm toast, prepared from ordinary white sliced bread, are taken immediately from the toaster to a plate, so that various butters, margarines, and the reduced fat table spread of the present invention can be spread on the fresh warm toast. Moreover, the temperature or storage properties of the various butters, margarines, and table spreads, are varied.

Thus, in one test, butter, margarine, and the reduced-fat table spread of the present invention are removed from the refrigerator at the same time that the toast is taken from the toaster, to be spread on the toast. The butter is not capable of being spread; each of the margarine and the reduced-fat table spread of the present invention are easily spreadable on the fresh warm toast.

In another test, the butter, margarine, and reduced-fat table spread of the present invention have each been removed from the refrigerator and placed in an ambient room temperature of about 23°C for about 30 minutes. When those samples are spread onto warm fresh toast, the butter is quite reasonably spreadable, as are the margarine and the reduced-fat table spread.

In a third test, the butter, margarine, and reduced-fat table spread of the present invention have been removed from the refrigerator for approximately 2 hours before being spread onto fresh warm toast. In this case, the butter and the margarine each tended to be absorbed almost immediately by the toast, so as not to be spreadable; whereas the reduced-fat table spread of the present invention remained spreadable even under these conditions.

However, it must be noted that, as a consequence of the high water content and low fat content of the reduced-fat table spreads of the present invention, they are not suitable for frying.

There has been described reduced-fat table spreads, which comprise from the 5% to 20% by weight of non-fat milk solids, vegetable oil, water, other trace constituents; and which may also comprise other protein and colloid carrier constituents which may also contribute to the protein coagulation by which the water content of the table spread is bound and is found in a continuous phase dispersion, whereas the vegetable oil content of the table spread is in a discontinuous phase suspended in a continuous phase dispersion.

Methods for production of reduced-fat table spreads in keeping with the present invention have been described. It has been noted that, for the most part, all of the necessary equipment and apparatus for production of the reduced-fat table spreads in the keeping with the present invention will be found in convention bulk milk handling and packaging facilities or commercial dairies, or on conventional margarine production facilities.

It has been noted above that, with the exception for its suitability for frying, the reduced-fat table spread of the present invention may be used in essentially the same manner and for the same purposes as conventional butters and margarines. Indeed, the reduced fat table spread of the present invention demonstrated superior qualities when subjected to the "warm toast" test than either conventional butter or conventional margarines.

Moreover, a further advantage of the reduced-fat table spread of the present invention is that it is spreadable at refrigeration temperatures on bread products of all sorts. In other words, at typical refrigeration temperatures of, say, 3°C up to 8°C or 10°C, a reduced-fat table spread according to the present invention may be taken directly from the refrigerator and spread on soft bread, as well as on toast, toasted bagels, rolls, buns, and the like. Moreover, as noted, the reduced fat table spread of the present invention may be kept at room temperature for a period of up to several hours and still be capable of being spread on toast or toasted bagels, and the like.

Finally, the reduced-fat table spreads of the present invention provide products which can be used in place of conventional butter or margarine, except for frying as noted above, but which permit lower caloric intake than butter or margarine, and lower cholesterol intake than butter, while maintaining the same appearance, flavour, consistency, rheology, and mouth-feel of conventional butters or margarines.

Other modifications and alterations may be used in the design and manufacture of the apparatus of the present invention without departing from the spirit and scope of the accompanying claims.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not to the exclusion of any other integer or step or group of integers or steps.

Moreover, the word "substantially" when used with an adjective or adverb is intended to enhance the scope of the particular characteristic; e.g., substantially planar is intended to mean planar, nearly planar and/or exhibiting characteristics associated with a planar element.

WHAT IS CLAIMED IS:

1. A reduced-fat table spread which is spreadable at refrigeration temperature, and at temperatures up to 25°C, and which has an appearance, colour, consistency, rheology, and mouth-feel similar to that of butter or margarine;

wherein said table spread has a formulation comprising 45% to 60% by weight of water, 5% to 20% by weight of non-fat milk solids having protein constituents, 0% to 5% of other protein and colloid carrier constituents chosen from the group consisting of gums, starches, egg whites, albumen, and mixtures thereof, 30% to 50% by weight of vegetable oil, 0% to 1.2% by weight of salt, and 0 to trace amounts of potassium sorbate, sodium benzoate, citric acid, lecithin, butter flavour ingredient, butter culture ingredient, and colour ingredient;

wherein each of the butter flavour ingredient, butter culture ingredient, and colour ingredient, when used, is compatible with the vegetable oil and with non-fat milk solids;

wherein the water content of said table spread is bound by the protein constituents of said non-fat milk solids, and by said other protein and colloid carrier constituents when present, in a continuous phase dispersion (34); and

wherein said vegetable oil content is in a discontinuous phase (32) suspended in said continuous phase dispersion.

2. The reduced-fat table spread of claim 1, wherein the vegetable oil possesses a melting curve characteristic, measured on a nuclear magnetic resonance (N.M.R.) basis, as follows:

10°C — 40-60
20°C — 10-26
30°C — 0-5

3. The reduced-fat table spread of claim 1, wherein said trace ingredients are present in the following amounts, based on per cent by weight:

potassium sorbate	0 - 0.15%
sodium benzoate	0 - 0.15%
citric acid	0 - 0.15%
lecithin	0 - 0.60%
flavour or culture	0 - 0.35%
butter colour	0 - 0.03%

4. The reduced-fat table spread of claim 3, having a formulation as follows, based on per cent by weight:

water	48%
non-fat milk solids	12%
vegetable oil	38%
salt	1%
potassium sorbate	0.10%
citric acid	0.10%
lecithin	0.50%
flavour or culture	0.28%
butter colour	0.02%

5. The reduced-fat table spread of claim 1, wherein said non-fat milk solids are derived from the group consisting of dry skim milk solids, buttermilk solids, dry casein solids, dry caseinates, dry whey protein solids, and mixtures thereof.

6. The reduced-fat table spread of claim 1, wherein said water content and at least a portion of said non-fat milk solids content are derived from skim milk.

7. The reduced-fat table spread of claim 1, wherein said water content and said non-fat milk solids content are derived from skim milk which has been

fortified with additional non-fat milk solids so as to provide said 5% to 20% by weight of non-fat milk solids.

8. The reduced-fat table spread of claim 1, wherein said water content and at least a portion of said non-fat milk solids content are derived from a mixture of water and whey.

9. The reduced-fat table spread of claim 1, wherein said water content and said non-fat milk solids content are derived from a mixture of water and whey so as to provide said 45% to 60% by weight of water and said 5% to 20% by weight of non-fat milk solids.

10. The reduced-fat table spread of claim 1, wherein said water content and said non-fat milk solids content are derived from a mixture of water and whey which has been fortified with additional non-fat milk solids so as to provide said 45% to 60% by weight of water and said 5% to 20% by weight of non-fat milk solids.

11. The reduced-fat table spread of claim 1, wherein said water content and said non-fat milk solids content are derived from a mixture of skim milk and whey so as to provide said 45% to 60% by weight of water and said 5% to 20% by weight of non-fat milk solids.

12. The reduced-fat table spread of claim 1, wherein said water content and said non-fat milk solids content are derived from a mixture of water and whey which has been fortified with additional non-fat milk solids so as to provide said 45% to 60% by weight of water and said 5% to 20% by weight of non-fat milk solids.

13. The reduced-fat table spread of claim 1, wherein said vegetable oil is chosen from the group consisting of unhydrogenated vegetable oils, hydrogenated vegetable oils, blended vegetable oils, and mixtures thereof.

14. The reduced-fat table spread of claim 5, wherein said dry caseinate is sodium caseinate.

15. A method for production of a reduced-fat table spread which is spreadable at refrigeration temperature, and at temperatures up to 25°C, and which has a formulation comprising 45% to 60% by weight of water, 5% to 20% by weight of non-fat milk solids having protein constituents, 0% to 5% of other protein and colloid carrier constituents chosen from the group consisting of gums, starches, egg whites, albumen, and mixtures thereof, 30% to 50% by weight of vegetable oil, 0% to 1.2% by weight of salt, and 0 to trace amounts of potassium sorbate, sodium benzoate, citric acid, lecithin, butter flavour ingredient, butter culture ingredient, and colour ingredient; and

wherein the water content of said table spread is bound by the protein constituents of said non-fat milk solids, and by said other protein and colloid carrier constituents when present, in a continuous phase dispersion thereof (34), and said vegetable oil content is in a discontinuous phase (32) suspended in said continuous phase dispersion; said method comprising the steps of:

(a) selecting a quantity of non-fat milk solids (40) and adding the non-fat milk solids to a selected quantity of water, where the temperature of said water is 2°C to 40°C;

(b) continuously stirring (44) said non-fat milk solids and water so as to form a milk solids slurry, while maintaining the temperature thereof below 40°C;

(c) optionally, adding a selected quantity of said other protein and colloid carrier constituents (46) to said milk solids slurry, while maintaining the temperature thereof below 40°C;

(d) adding a selected quantity of vegetable oil (42) to said continuously stirred milk solids slurry, while maintaining the temperature thereof below 40°C, to form a continuously stirred milk solids slurry mixture;

(e) adding any of said optional trace amount ingredients (48) to said continuously stirred milk solids slurry mixture, while maintaining the temperature thereof below 40°C; whereby said vegetable oil and said optional added trace amount ingredients are held in suspension in said continuously stirred milk solids slurry mixture;

(f) heating said continuously stirred milk solids slurry mixture to a temperature of 72°C to 90°C, and maintaining said milk solids slurry at a temperature of 72°C to 90°C for a period of 10 seconds to 10 minutes (52), so as to permit coagulation of the protein constituents of said non-fat milk solids, and of said other protein and colloid carrier constituents when present, and so as to pasteurize said stirred milk solids slurry;

(g) homogenizing (56) said heated milk solids slurry mixture at a temperature of 25°C to 72°C;

(h) transferring the homogenized mixture through a heat exchanger (58, 62) to a filling machine (66), so as to reduce the temperature of said homogenized mixture to 8°C to 15°C; and

(i) transferring selected quantities of said cooled homogenized mixture to containers therefor (68), for storage as reduced-fat table spread.

16. The method of claim 15, comprising the further step of:

(j) storing said reduced-fat table spread at temperatures below 8°C.

17. The method of claim 15, wherein said butter flavour ingredient is added to said continuously stirred milk solids slurry mixture after step (f) and before step (g).

18. The method of claim 15, wherein the vegetable oils possesses a melting curve characteristic, measured on a nuclear magnetic resonance (N.M.R.) basis, as follows:

10°C	— 40-60
20°C	— 10-26
30°C	— 0-5

19. The method of claim 15, wherein said non-fat milk solids are derived from the group consisting of dry skim milk solids, buttermilk solids, dry casein solids, dry caseinates, dry whey protein solids, and mixtures thereof.

20. The method of claim 15, wherein said heat exchanger is a swept surface heat exchanger.

21. The method of claim 15, wherein the duration of step (f) is 35 to 60 seconds.

22. The method of claim 15, wherein said trace ingredients are present in the following amounts, based on per cent by weight:

potassium sorbate	0 - 0.15%
sodium benzoate	0 - 0.15%
citric acid	0 - 0.15%
lecithin	0 - 0.60%
flavour or culture	0 - 0.35%
butter colour	0 - 0.03%

23. The method of claim 15, wherein the resultant reduced-fat table spread has a formulation as follows, based on per cent by weight:

water	48%
non-fat milk solids	12%
vegetable oil	38%
salt	1%
potassium sorbate	0.10%
citric acid	0.10%
lecithin	0.50%
flavour or culture	0.28%
butter colour	0.02%

24. A method for production of a reduced-fat table spread which is spreadable at refrigeration temperature, and at temperatures up to 25°C, and which has a formulation comprising 45% to 60% by weight of water, 5% to 20% by weight of non-fat milk solids having protein constituents, 0% to 5% of other protein and colloid carrier constituents chosen from the group consisting of gums, starches, egg whites, albumen, and mixtures thereof 30% to 50% by weight of vegetable oil, 0% to 1.2% by weight of salt, and 0 to trace amounts of potassium sorbate, sodium benzoate, citric acid, lecithin, butter flavour ingredient, butter culture ingredient, and colour ingredient; and

wherein the water content of said table spread is bound by the protein constituents of said non-fat milk solids, and by said other protein and colloid carrier constituents when present, in a continuous phase dispersion thereof (34), and said vegetable oil content is in a discontinuous phase (32) suspended in said continuous phase dispersion; said method comprising the steps of:

(a) selecting a quantity of non-fat milk solids (40) and adding the non-fat milk solids to a selected quantity of skim milk, where the temperature of said skim milk is 2°C to 40°C;

(b) continuously stirring (44) said non-fat milk solids and skim milk so as to form a milk solids slurry, while maintaining the temperature thereof below 40°C;

(c) optionally, adding a selected quantity of said other protein and colloid carrier constituents (46) to said milk solids slurry, while maintaining the temperature thereof below 40°C;

(d) adding a selected quantity of vegetable oil (42) to said continuously stirred milk solids slurry, while maintaining the temperature thereof below 40°C, to form a continuously stirred milk solids slurry mixture;

(e) adding any of said optional trace amount ingredients (48) to said continuously stirred milk solids slurry mixture, while maintaining the temperature thereof below 40°C; whereby said vegetable oil and said optional added trace amount ingredients are held in suspension in said continuously stirred milk solids slurry mixture;

(f) heating said continuously stirred milk solids slurry mixture to a temperature of 72°C to 90°C, and maintaining said milk solids slurry at a temperature of 72°C to 90°C for a period of 10 seconds to 10 minutes (52), so as to permit coagulation of the protein constituents of said non-fat milk solids, and of said other protein and colloid carrier constituents when present, and so as to pasteurize said stirred milk solids slurry;

(g) homogenizing (56) said heated milk solids slurry mixture at a temperature of 25°C to 72°C;

(h) transferring the homogenized mixture through a heat exchanger (58, 62) to a filling machine (66), so as to reduce the temperature of said homogenized mixture to 8°C to 15°C; and

(i) transferring selected quantities of said cooled homogenized mixture to containers therefor (68), for storage as reduced-fat table spread.

25. A method for production of a reduced-fat table spread which is spreadable at refrigeration temperature, and at temperatures up to 25°C, and which has a formulation comprising 45% to 60% by weight of water, 5% to 20% by weight of non-fat milk solids having protein constituents, 0% to 5% of protein and other colloid carrier constituents chosen from the group consisting of gums, starches, egg whites, albumen, and mixtures thereof 30% to 50% by weight of vegetable oil, 0% to 1.2% by weight of salt, and 0 to trace amounts of potassium sorbate, sodium benzoate, citric acid, lecithin, butter flavour ingredient, butter culture ingredient, and colour ingredient; and

wherein the water content of said table spread is bound by the protein constituents of said non-fat milk solids, and by said other protein and colloid carrier constituents when present, in a continuous phase dispersion thereof (34), and said vegetable oil content is in a discontinuous phase (32) suspended in said continuous phase dispersion; said method comprising the steps of:

(a) selecting a quantity of whey (40) and adding the whey to a selected quantity of water, where the temperature of said water is 2°C to 40°C;

(b) continuously stirring (44) said whey and water so as to form a milk solids slurry, while maintaining the temperature thereof below 40°C;

(c) optionally, adding a selected quantity of said other protein and colloid carrier constituents (46) to said milk solids slurry, while maintaining the temperature thereof below 40°C;

(d) adding a selected quantity of vegetable oil (42) to said continuously stirred milk solids slurry, while maintaining the temperature thereof below 40°C, to form a continuously stirred milk solids slurry mixture;

(e) adding any of said optional trace amount ingredients (48) to said continuously stirred milk solids slurry mixture, while maintaining the temperature thereof below 40°C; whereby said

vegetable oil and said optional added trace amount ingredients are held in suspension in said continuously stirred milk solids slurry mixture;

(f) heating said continuously stirred milk solids slurry mixture to a temperature of 72°C to 90°C, and maintaining said milk solids slurry at a temperature of 72°C to 90°C for a period of 10 seconds to 10 minutes (52), so as to permit coagulation of the protein constituents of said non-fat milk solids, and of said other protein and colloid carrier constituents when present, and so as to pasteurize said stirred milk solids slurry;

(g) homogenizing (56) said heated milk solids slurry mixture at a temperature of 25°C to 72°C;

(h) transferring the homogenized mixture through a heat exchanger (58, 62) to a filling machine (66), so as to reduce the temperature of said homogenized mixture to 8°C to 15°C; and

(i) transferring selected quantities of said cooled homogenized mixture to containers therefor (68), for storage as reduced-fat table spread.

26. A method for production of a reduced-fat table spread which is spreadable at refrigeration temperature, and at temperatures up to 25°C, and which has a formulation comprising 45% to 60% by weight of water, 5% to 20% by weight of non-fat milk solids having protein constituents, 0% to 5% of other protein and colloid carrier constituents chosen from the group consisting of gums, starches, egg whites, albumen, and mixtures thereof 30% to 50% by weight of vegetable oil, 0% to 1.2% by weight of salt, and 0 to trace amounts of potassium sorbate, sodium benzoate, citric acid, lecithin, butter flavour ingredient, butter culture ingredient, and colour ingredient; and

wherein the water content of said table spread is bound by the protein constituents of said non-fat milk solids, and by said other protein and

colloid carrier constituents when present, in a continuous phase dispersion thereof (34), and said vegetable oil content is in a discontinuous phase (32) suspended in said continuous phase dispersion; said method comprising the steps of:

(a) selecting a quantity of whey (40) and adding the whey to a selected quantity of skim milk, where the temperature of said skim milk is 2°C to 40°C;

(b) continuously stirring (44) said whey and skim milk so as to form a milk solids slurry, while maintaining the temperature thereof below 40°C;

(c) optionally, adding a selected quantity of said other protein and colloid carrier constituents (46) to said milk solids slurry, while maintaining the temperature thereof below 40°C;

(d) adding a selected quantity of vegetable oil (42) to said continuously stirred milk solids slurry, while maintaining the temperature thereof below 40°C, to form a continuously stirred milk solids slurry mixture;

(e) adding any of said optional trace amount ingredients (48) to said continuously stirred milk solids slurry mixture, while maintaining the temperature thereof below 40°C; whereby said vegetable oil and said optional added trace amount ingredients are held in suspension in said continuously stirred milk solids slurry mixture;

(f) heating said continuously stirred milk solids slurry mixture to a temperature of 72°C to 90°C, and maintaining said milk solids slurry at a temperature of 72°C to 90°C for a period of 10 seconds to 10 minutes (52), so as to permit coagulation of the protein constituents of said non-fat milk solids, and of said other protein and colloid carrier constituents when present, and so as to pasteurize said stirred milk solids slurry;

(g) homogenizing (56) said heated milk solids slurry mixture at a temperature of 25°C to 72°C;

(h) transferring the homogenized mixture through a heat exchanger (58, 62) to a filling machine (66), so as to reduce the temperature of said homogenized mixture to 8°C to 15°C; and

(i) transferring selected quantities of said cooled homogenized mixture to containers therefor (68), for storage as reduced-fat table spread.

27. The method of claim 15, wherein said vegetable oil is chosen from the group consisting of unhydrogenated vegetable oils, hydrogenated vegetable oils, blended vegetable oils, and mixtures thereof.

28. The method of claim 19, wherein said dry caseinate is sodium caseinate.

29. The method of claim 15, wherein the temperature at which steps (a), (b), (c), (d), and (e) are carried out is 2°C to 20°C.

30. The method of claim 15, wherein the temperature of said water in step (a) is 2°C to 5°C, wherein the temperature of said vegetable oil in step (d) is 20°C to 40°C, and wherein the temperature at which steps (b), (c), (d), and (e) are carried out is 20°C to 40°C.

31. The method claim 24, comprising the further step of:

(j) storing said reduced-fat table spread at temperatures below 8°C.

32. The method of claim 24, wherein the temperature at which steps (a), (b), (c), (d), and (e) are carried out is 2°C to 20°C.

33. The method of claim 24, wherein the temperature of said skim milk in step (a) is 2°C to 5°C, wherein the temperature of said vegetable oil in step (d) is 20°C to 40°C, and wherein the temperature at which steps (b), (c), (d), and (e) are carried out is 20°C to 40°C.

34. The method of claim 24, wherein the vegetable oils possesses a melting curve characteristic, measured on a nuclear magnetic resonance (N.M.R.) basis, as follows:

10°C —	40-60
20°C —	10-26
30°C —	0-5

35. The method of claim 24, wherein said non-fat milk solids are derived from the group consisting of dry skim milk solids, buttermilk solids, dry casein solids, dry caseinates, dry whey protein solids, and mixtures thereof.

36. The method of claim 24, wherein the duration of step (f) is 35 to 60 seconds.

37. The method of claim 25, comprising the further step of:

(j) storing said reduced-fat table spread at temperatures below 8°C.

38. The method of claim 25, wherein the temperature at which steps (a), (b), (c), (d), and (e) are carried out is 2°C to 20°C.

39. The method of claim 25, wherein the temperature of said water in step (a) is 2°C to 5°C, wherein the temperature of said vegetable oil in step (d) is 20°C to 40°C, and wherein the temperature at which steps (b), (c), (d), and (e) are carried out is 20°C to 40°C.

40. The method of claim 25, wherein the vegetable oils possesses a melting curve characteristic, measured on a nuclear magnetic resonance (N.M.R.) basis, as follows:

10°C — 40-60
20°C — 10-26
30°C — 0-5

41. The method of claim 24, wherein said non-fat milk solids are derived from the group consisting of dry skim milk solids, buttermilk solids, dry casein solids, dry caseinates, dry whey protein solids, and mixtures thereof.

42. The method of claim 24, wherein the duration of step (f) is 35 to 60 seconds.

43. The method of claim 26, comprising the further step of:

(j) storing said reduced-fat table spread at temperatures below 8°C.

44. The method of claim 26, wherein the temperature at which steps (a), (b), (c), (d), and (e) are carried out is 2°C to 20°C.

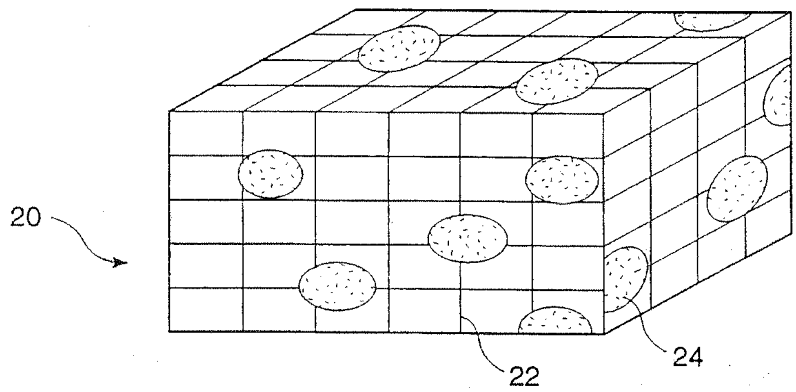
45. The method of claim 26, wherein the temperature of said skim milk in step (a) is 2°C to 5°C, wherein the temperature of said vegetable oil in step (d) is 20°C to 40°C, and wherein the temperature at which steps (b), (c), (d), and (e) are carried out is 20°C to 40°C.

46. The method of claim 26, wherein the vegetable oils possesses a melting curve characteristic, measured on a nuclear magnetic resonance (N.M.R.) basis, as follows:

10°C — 40-60
20°C — 10-26
30°C — 0-5

47. The method of claim 26, wherein said non-fat milk solids are derived from the group consisting of dry skim milk solids, buttermilk solids, dry casein solids, dry caseinates, dry whey protein solids, and mixtures thereof.

48. The method of claim 26, wherein the duration of step (f) is 35 to 60 seconds.



Prior Art

Fig. 1

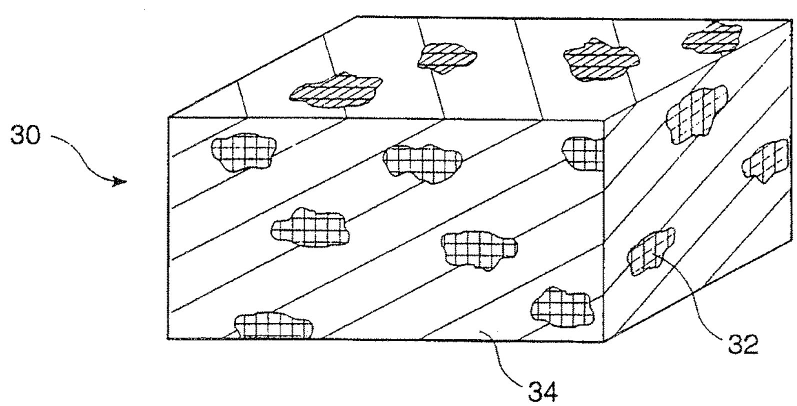


Fig. 2

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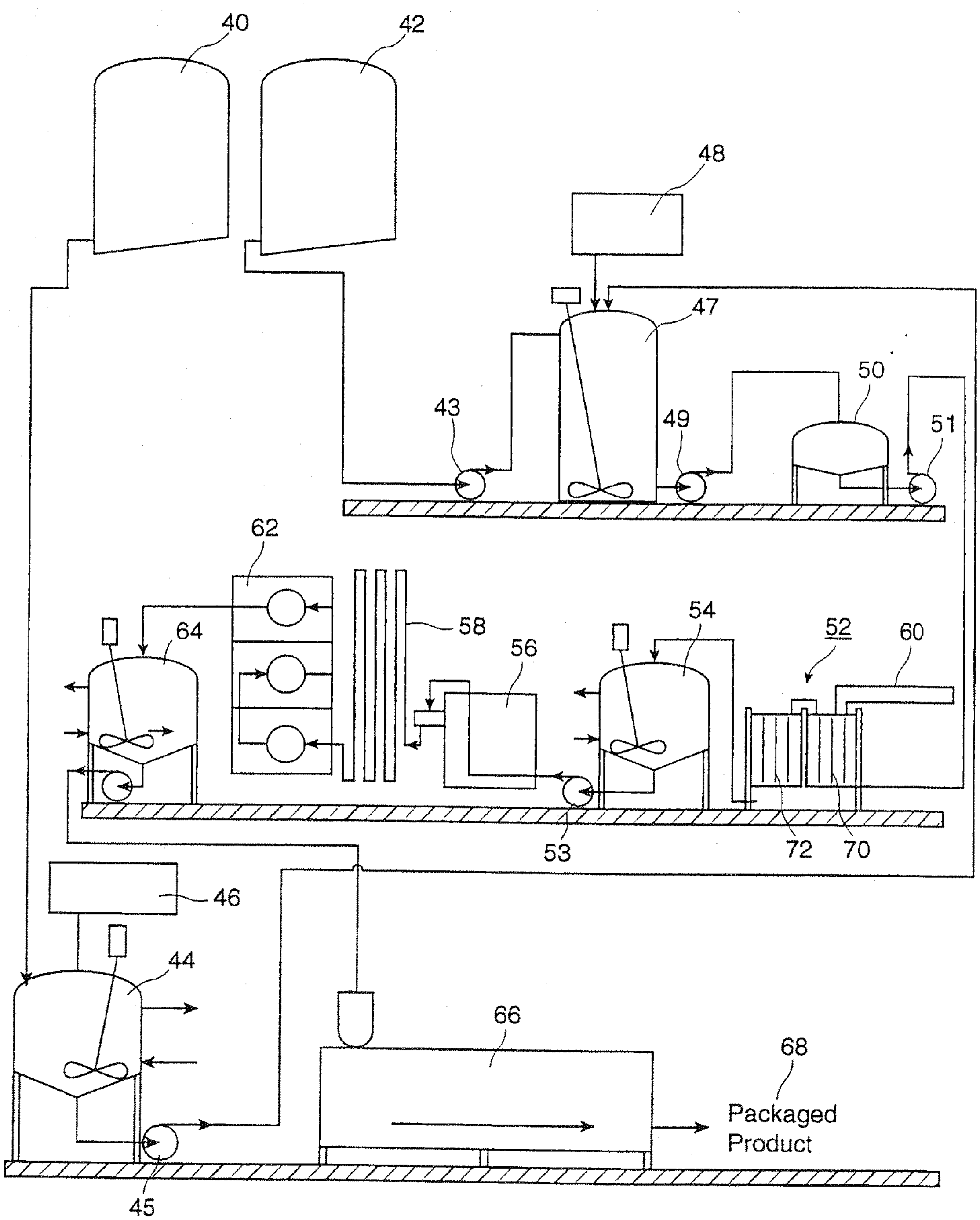
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Product
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Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 99/00099

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A23D7/015

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A23D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 May 1999	04/06/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Dekeirel, M

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 99/00099

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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